Achieving Cost Savings by Reforming Surfaces of Die-Casting Die

Through these innovative methods, Sintokogio has observed an increase to the fatigue life of die casting die. Under typical conditions, die-casting die life can be extended two to three times.

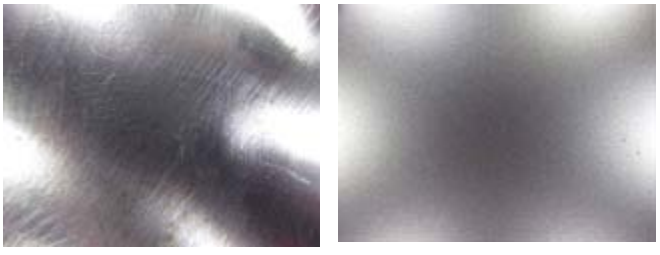
READERS OF THE SHOT PEENER are well aware of the many benefits of shot peening in increasing surface residual stress. In this article we will show how increased surface residual stress can lead to improvements in production and in fatigue life in die-casting die. We will discuss two methods for improving die-casting die life through shot peening called D-CHECK and D-SCC. We will also present one method for improving the products quality called D-FLOW. By using these methods, die-casters can reduce the number of defects and increase the fatigue life of the die-casting die. These improvements directly translate to cost and energy savings for manufacturers.

Die Casting

Readers will be familiar with die-casting, but we include a very short explanation of the process for clarity. Die casting is a metal casting process that is characterized by forcing molten metal under high pressure into a mold cavity. The mold cavity is created using two hardened tool steel dies, which have been machined into shape and work similarly to an injection mold during the process. Die castings are known for high production efficiency and high strength.

D-CHECK: Improving service life of die-casting die

The primary factor that effects die-casting die service life is heat checking. (Heat checking is the fine cracks on the surface of a die which produce corresponding raised veins on die castings. Heat checking is caused by repeated heating of the die surface by injected molten alloys.) The D-CHECK process uses shot peening to prevent heat checking and extend the life of die-casting die by two to three times. The obvious benefit of extending service life is productivity improvements and cost reductions. Cost reductions are achieved by maintenance reduction and by reducing cost associated with creating new die. Surface property of after D-CHECK is shown in Fig.1



Before D-CHECK **After D-CHECK**

Fig.1 Surface property before and after D-CHECK

D-SCC: Prevent cracking in water-cooling hole of die-casting die

Water-cooling holes are drilled increasingly closer to the cavity to obtain quicker cooling, but die-cast users report defects due to water that seeps through cracks from the water cooling hole. (Fig.2) The D-SCC uses shot peening to protect water-cooling holes from stress corrosion cracking (SCC). With D-SCC, the peening is done specifically in the water-cooling hole of the die-casting die and can be performed on holes with a diameter as small as 4 mm and a depth of up to 200 mm by special nozzle. (Fig.3) In actual mass production lines, fatigue life of die expanded three to four times compared with non-peened die.

The benefits of heat check prevention and stress corrosion cracking reduction are achieved through the increase of residual stress as a result of the shot peening. The surface residual stress is increased from -250 MPa for untreated to -1500MPa for surfaces that have been treated by peening.

Fig.2 The stress corrosion cracking that appeared in the water-cooling hole

Fig.3 Nozzle for internal surface

D-FLOW: Die-casting products defect reduction method

The D-FLOW process greatly reduces casting defects by modifying the die casting mold surfaces. This surface processing method contributes to improved quality, increased energy savings, reduced carbon footprint, and increased cost savings by reducing products defect.

After implementing the D-FLOW process, we saw eddy flows caused by dimpling return the colder surface molten material to the inside and help to maintain the molten material temperature by providing the heat of the internal material to the surface. The dimpling also controls reduction in molten material temperature by decreasing the contact surface. Though results depend on conditions, we observed a 50% reduction to the defect occurrence rate. Reductions were seen in peeling, flow lines, blowholes, and soldering. (Fig.4)

Before D-FLOW **After D-FLOW**

Fig.4 The soldering which occurred on the product surface.